

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-227596

(43)Date of publication of application : 15.08.2000

(51)Int.Cl.

G02F 1/1337

G02F 1/1335

G02F 1/1339

G02F 1/1343

G02F 1/136

(21)Application number : 11-029053

(71)Applicant : HITACHI LTD

(22)Date of filing : 05.02.1999

(72)Inventor : YANAGAWA KAZUHIKO

ASHIZAWA KEIICHIRO

ISHII MASAHIRO

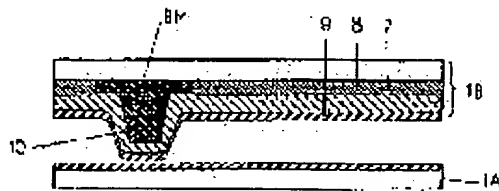
HIKIBA MASAYUKI

(54) LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a liquid crystal display device showing no irregular display due to disturbance in alignment by controlling the direction of alignment treatment of an alignment layer almost parallel to the border line of a light-shielding region.

SOLUTION: A black matrix BM is formed on the liquid crystal side of a transparent substrate on a filter substrate 1B side, and projections are formed as a part of the black matrix BM so that the projections act as a spacer 10. A rather thicker light-shielding material layer than that for a normal region is formed all over the projections 10. The black matrix BM is formed to cover gate lines and the vicinity of the gate lines and to cover drain lines and the vicinity of the drain lines. A color filter 7 is formed in the opening of the black matrix BM, on which a flattening layer 8 is formed, and further an alignment layer 9 is formed to cover the flattening layer 8. The alignment layer 9 is rubbed along the extending direction of the drain lines. Namely, a roller is moved along the extending direction of the drain lines while the roller is in contact with the alignment layer 9.



* NOTICES *

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to a liquid crystal display, and relates to a liquid crystal display equipped with the spacer which intervenes between the transparent substrates by which opposite arrangement is especially carried out through liquid crystal.

[0002]

[Description of the Prior Art] By making a spacer intervene between the transparent substrates by which opposite arrangement is carried out through liquid crystal, the thickness of liquid crystal can be set constant and generating of display unevenness can be prevented.

[0003] As this spacer, there is a bead-like thing, for example and opposite arrangement of the substrate of another side is carried out in the state where these spacers were made scattered in the field by the side of the liquid crystal of one substrate.

[0004] However, since the spacers of the shape of this bead are made scattered in an irregular substrate side, even if other spacers will be positioned in a crevice by heights and a certain spacer carries out opposite arrangement of the substrate of another side, the gap of those substrates may not become as predetermined.

[0005] On the other hand, there are some which the field by the side of the liquid crystal of one substrate was made to fix to the predetermined part of this substrate beforehand, and were formed in it as other spacers.

[0006] In this case, when carrying out opposite arrangement of the substrate of another side by forming this spacer in a crevice among irregular substrate sides, the gap of those substrates can be set up as predetermined.

[0007]

[Problem(s) to be Solved by the Invention] However, after the latter spacer formed it, it had to cover this spacer and had to form the material film of an orientation film, orientation processing had to be carried out for the aforementioned material film which the height has generated with this spacer, and making this orientation film produce the so-called orientation disorder was checked.

[0008] That is, it is because the orientation as predetermined becomes impossible at the tooth back of a height in which orientation processing is performed by rotating a roller in the fixed direction along with this material film surface, and this spacer is formed in this case.

[0009] Since a spacer is formed in the display which is a set of a pixel, this orientation disorder will cause a different display state from other portions, and will cause [so-called] display unevenness.

[0010] this invention was made based on such a situation, and is for the purpose to offer a liquid crystal display without the display unevenness by orientation disorder.

[0011]

[Means for Solving the Problem] It will be as follows if the outline of a typical thing is briefly explained among invention indicated in this application.

[0012] That is, the liquid crystal display by this invention is characterized by the direction of orientation

processing of the orientation film with which the spacer formed in the shading field of a substrate was covered, and orientation processing was made, and the aforementioned orientation film being parallel mostly with the boundary line of the aforementioned shading field.

[0013] Thus, in order that the constituted liquid crystal display may raise a numerical aperture, it is made for this shading field to cover the orientation disorder of the orientation film which originates in a spacer in the shading fields (black matrix etc.) formed in a necessary minimum area.

[0014] For this reason, since this orientation disorder does not have visual practice *****, a thing without display unevenness can be obtained.

[0015]

[Embodiments of the Invention] Hereafter, the example of the liquid crystal display by this invention is explained using a drawing.

[0016] [Example 1] Drawing 1 is the plan showing one pixel in each pixel of the liquid crystal display called the so-called horizontal electric-field method.

[0017] Here, in the liquid crystal display of this example, what has a dielectric constant anisotropy positive in the liquid crystal is used.

[0018] Each pixel is arranged in the shape of a matrix, and constitutes the display. For this reason, the composition of the pixel shown in drawing 1 is the same as the right and left and the composition of a pixel which adjoins up and down.

[0019] First, the scanning signal line (gate line) 2 which extends in the x in drawing direction among the transparent substrates by which opposite arrangement is carried out through liquid crystal in the field by the side of the liquid crystal of one transparent substrate 1 is formed for example, of the chromium layer. As shown all over drawing, this gate line 2 is formed in the pixel field bottom, and takes the largest possible field that functions as a pixel substantially.

[0020] And a gate signal is supplied from the outside of a display, and this gate line 2 makes the below-mentioned TFT TFT drive.

[0021] Moreover, the opposite voltage-signal line 4 of a pixel field which extends in the x in drawing direction in the center is mostly formed of the same material as the gate line 2.

[0022] Counterelectrode 4A is formed in the opposite voltage-signal line 4 in one, and this counterelectrode 4A is mostly formed by the 'H' character-like pattern with this opposite voltage-signal line 4 in the pixel field.

[0023] The signal which serves as criteria to the video signal supplied to the pixel electrode 5 mentioned later is supplied through this opposite voltage-signal line 4, and this counterelectrode 4A makes the electric field of the intensity corresponding to the aforementioned video signal generate between these pixel electrodes 5.

[0024] This electric field have an parallel component to the 1st page of a transparent substrate, and control the light transmittance of liquid crystal by the electric field which consist of this component. The liquid crystal display explained in this example serves as a reason called the so-called horizontal electric-field method.

[0025] In addition, a reference signal is supplied to the opposite voltage-signal line 4 from the outside of a display.

[0026] And the insulator layer (not shown) which consists of a silicon nitride, also including this gate line 2 and the opposite voltage-signal line 4 is formed in the 1st page of the transparent substrate in which the gate line 2 and the opposite voltage-signal line 4 were formed in this way.

[0027] This insulator layer has a function as the dielectric film in the function as a layer insulation film to the gate line 2 and the opposite voltage-signal line 4, and the formation field of the below-mentioned capacitative element Cadd in the function as the gate insulator layer, and the formation field of the below-mentioned video-signal line (drain wire) 3 in the formation field of the below-mentioned TFT TFT.

[0028] In such an insulator layer, it superimposes on the gate line 2, TFT TFT is formed, and the semiconductor layer 6 which consists of an amorphous silicon is formed in the portion.

[0029] And the so-called TFT of the reverse stagger structure which uses a part of aforementioned gate

line 2 as a gate electrode is constituted by forming drain electrode 3A and source electrode 5A in the upper surface of the semiconductor layer 6.

[0030] Here, as for drain electrode 3A on the semiconductor layer 6, and source electrode 5A, the pixel electrode 5 is simultaneously formed at the time of formation of a drain wire 3.

[0031] That is, drain electrode 3A which the drain wire 3 which extends in the direction of y in drawing is formed, and is formed in this drain wire 3 in one is formed on the semiconductor layer 6.

[0032] Here, as shown all over drawing, a drain wire 3 is formed in the left-hand side of a pixel field, and takes the largest possible field that functions as a pixel substantially.

[0033] Moreover, source electrode 5A is formed simultaneously with a drain wire 3, and is formed in one with the pixel electrode 5 in this case.

[0034] As this pixel electrode 5 runs between counterelectrode 4A mentioned above, and it extends in the direction of y in drawing, it is formed in it. If it puts in another way, counterelectrode 4A will be arranged mostly at equal intervals at both the sides of the pixel electrode 5, and electric field will be made to generate between this pixel electrode 5 and counterelectrode 4A.

[0035] Here, by being constituted by the reverse '*' character-like pattern, for example, the pixel electrode 5 is constituted so that each counterelectrode 4A which was crooked bordering on the opposite voltage-signal line 4 and which counters with this pixel electrode 5 in connection with this may also be estranged in parallel to the pixel electrode 5 and the width of face may change so that it may become clear out of drawing.

[0036] That is, as the crooked pixel electrode 5 shows the longitudinal direction in this drawing, when it has uniform width of face, in the side by the side of the drain wire 3, in parallel with this drain wire 3, in the side by the side of the pixel electrode 5, counterelectrode 4A positioned by both the side becomes parallel to this pixel electrode 5, and is formed.

[0037] Thereby, the direction of the electric field E generated between the pixel electrode 5 and counterelectrode 4A is (-) theta to this opposite voltage highway 4 among drawing in the pixel field of the bottom bordering on the opposite voltage highway 4, and has become (+) theta to this opposite voltage highway 4 in the upper pixel field.

[0038] Thus, it is to make the directions of electric field E differ in a 1-pixel field (for you to be not necessarily a relation not only with the inside of a field of 1 pixel but other pixels) to rotate a liquid crystal molecule to an opposite direction to the fixed direction of initial orientation, respectively, and change a light transmittance.

[0039] By doing in this way, if a view is aslant leaned to the main viewing-angle direction of a liquid crystal display panel, it has composition which canceled un-arranging according to the viewing-angle dependency of the liquid crystal display panel of causing the inversion phenomenon of brightness.

[0040] in addition, in this example, the direction [in / a coincidence attachment **** cage and the orientation film mentioned later / almost / with the extension direction of a drain wire 3 / in the direction of initial orientation of a liquid crystal molecule] of rubbing is made along with a drain wire 3

[0041] For this reason, as for the direction theta of electric field mentioned above, a suitable value is set up by the relation with this initial orientation direction. Generally, this theta is smaller than the absolute value of an angle [as opposed to the drain wire 3 of electric field E in the absolute value of the angle to the gate line 2 of electric field E].

[0042] And in the aforementioned pixel electrode 5, the portion superimposed on the opposite voltage-signal line 4 is formed so that the area may be made to become size, and capacitive element Cadd is formed between these opposite voltage-signal lines 4. The dielectric film in this case is the insulator layer mentioned above.

[0043] This capacitive element Cadd is formed in order to store up comparatively long the video signal supplied to the pixel electrode 5. That is, by supplying a scanning signal from the gate line 2, TFT TFT turns on and the video signal from a drain wire 3 is supplied to the pixel electrode 5 through this TFT TFT. Then, even when TFT TFT turns off, the video signal supplied to the pixel electrode 5 is accumulated by this capacitive element Cadd.

[0044] And throughout the front face of the transparent substrate 1 formed in this way, the protective

coat (not shown) which consists for example, of a silicon nitride is formed, for example, the direct contact to the liquid crystal of TFT TFT can be avoided now.

[0045] Furthermore, the orientation film (not shown) which determines the direction of initial orientation of liquid crystal is formed in the upper surface of this protective coat. This orientation film carries out the clothing for example, of the synthetic-resin film, and is formed by making the rubbing processing which met in the extension direction of a drain wire as mentioned above on the front face.

[0046] Thus, a liquid crystal display panel will be completed by carrying out opposite arrangement of the transparent substrate which the transparent substrate by which surface treatment was made is called the so-called TFT substrate 1A, and liquid crystal is made to be placed between the fields in which the orientation film was formed, and is called the so-called filter base board 1B.

[0047] The light filter formed in the field by the side of the liquid crystal at the black matrix (the outside profile is shown in drawing 1) BM which draws the profile of a pixel field, and opening (it is equivalent to the center section except the circumference of a pixel field) of this black matrix, the orientation film which were formed by carrying out so that liquid crystal might be contacted are formed in filter base board 1B.

[0048] Here, like it by the side of TFT substrate 1A, the orientation film by the side of filter base board 1B carries out the clothing of the synthetic-resin film, and is formed by making the rubbing processing which met in the extension direction of a drain wire 3 as mentioned above on the front face.

[0049] the direction of orientation in each orientation film arranged through liquid crystal in the so-called liquid crystal display of a horizontal electric-field method -- each -- almost -- this direction -- it is -- the direction -- the case of this example -- the extension direction of a drain wire 3 -- almost -- coincidence attachment *****

[0050] Furthermore, in order to hold the gap between them between TFT substrate 1A and filter base board 1B by which opposite arrangement is mutually carried out through liquid crystal, the spacer 10 intervenes. As mentioned above, this cannot prevent generating of display unevenness for the thickness of liquid crystal more easily as a uniform thing.

[0051] Beforehand, it was fixed to the predetermined part and the spacer 10 in this case has been arranged, and in the case of this example, as it is superimposed on a drain wire 3, it is formed for example, in the filter base board 1B side.

[0052] Drawing 2 is drawing showing the cross section in the II-II line of drawing 1 . This salient object functions as the aforementioned spacer 10 by forming the black matrix BM in the field by the side of the liquid crystal of the transparent substrate by the side of filter base board 1B, and forming a salient object in a part of this black matrix BM.

[0053] This salient object can form a shading material layer thicker than usual in the whole surface, and can form it by the selective-etching method by well-known photolithography technology. Then, the black matrix BM can be formed by forming opening by the selective-etching method by photolithography technology again.

[0054] As this black matrix BM is shown in drawing 1 , the gate line 2 and its near, a drain wire 3, and its near are covered, and it is formed, and the opening exposes the field between the pixel electrode 5 and counterelectrode 4A, and as it covers the pixel electrode 5 and the edge of counterelectrode 4A, it is formed.

[0055] Although it can raise the numerical aperture of a pixel more if opening of a black matrix has large it, it is set as the grade which is sufficient for covering the disorder (generated near the pixel electrode 5 and the edge of counterelectrode 4A) of unnecessary electric field (generated between a drain wire 3 and counterelectrode 4A), and electric field by the maximum size.

[0056] And a light filter 7 is formed in opening of the black matrix BM, and as they are covered, the flat film 8 is formed and this flat film 8 is covered further, the orientation film 9 is formed.

[0057] As mentioned above, rubbing processing is made along the extension direction of a drain wire 3, and specifically, this orientation film 9 moves a roller 100 in the extension direction of a drain wire 3 in the state where the orientation film 9 was made to contact, as shown in drawing 3 .

[0058] In this case, as shown in this drawing, with the salient object, a roller 100 comes floating and un-

arranging [that sufficient orientation does not turn on the tooth-back side of this spacer 10 (generating of the orientation disorder 200)] produces the portion in which the spacer 10 is formed.

[0059] however, the display unevenness generate in the formation field of the black matrix currently beforehand formed as this portion is shown in drawing 1 , and according to this orientation disorder --
 **** -- it comes to do so the effect that there are nothings

[0060] In addition, although the orientation disorder resulting from a spacer 10 was constituted from this example so that it might be positioned in the black matrix BM, it cannot be overemphasized that you may especially be in the state which does not have the black matrix BM in this portion.

[0061] The orientation disorder resulting from the spacer 10 on which the drain wire 3 was overlapped is because it is covered with this drain wire 3 used as a shading field and the same effect is done so.

[0062] Moreover, when the opposite voltage-signal line 4 connected to counterelectrode 4A is made to extend in parallel with a drain wire 3, can also be constituted and is carried out in this way, even if it constitutes so that this spacer 10 may be superimposed on the opposite voltage-signal line 4, doing the same effect so cannot be overemphasized. It is because the opposite voltage-signal line 4 also serves as a shading field of this spacer 10.

[0063] [Example 2] Drawing 4 is the plan showing other examples of the liquid crystal display by this invention, and serves as drawing 1 and corresponding drawing.

[0064] In this drawing, the pattern of the gate line 2, the opposite voltage-signal line 4, counterelectrode 4A, a drain wire 3, and pixel electrode 5 grade is the same as that of drawing 1 .

[0065] In different composition from the case of drawing 1 , the liquid crystal used has the negative dielectric constant anisotropy first.

[0066] And TFT substrate 1A and filter base board 1B swerve, and the direction of rubbing of the near orientation film of ** (the direction of initial orientation) is made along the extension direction of the gate line 2.

[0067] Furthermore, the spacer 10 fixed to a substrate is superimposed by the gate line 2, and is to be made and arranged.

[0068] The orientation disorder of the orientation film resulting from a spacer 10 will be produced along with the gate line 2, and this orientation disorder will be covered in this case by the gate line 2 or the shading field by the black matrix BM.

[0069] [Example 3] Drawing 5 is the plan showing other examples of the liquid crystal display by this invention, and serves as drawing 1 and corresponding drawing.

[0070] And in the liquid crystal display of this example, what has a dielectric constant anisotropy positive in the liquid crystal is used. Moreover, the direction of initial orientation of the liquid crystal determined by the direction of rubbing of an orientation film is formed along with the gate line 2.

[0071] As compared with the case of drawing 1 , each patterns of the pixel electrode 5 and counterelectrode 4A differ first.

[0072] That is, the pixel electrode 5 and counterelectrode 4A are constituted, respectively, so that it may be mostly arranged with a gate line at parallel.

[0073] Specifically, the pixel electrode 5 extended along with the drain wire 3 which approaches from source electrode 5A of TFT TFT, and the pixel electrode 5 which functions substantially in a pixel field from the extension section has extended.

[0074] In this case, bordering on the opposite voltage-signal line 4, in the inside top of the drawing, each pixel electrode 5 has the angle of (-) theta, and is formed to the gate line 2, respectively, and in the bottom, to the gate line 2, each pixel electrode has the angle of (+) theta and is formed, respectively.

[0075] Moreover, counterelectrode 4A is extended and formed in the pixel field from the extension section of the opposite voltage-signal line 4 which met the drain wire (not shown) of another side contiguous to the aforementioned drain wire 3.

[0076] counterelectrode 4A in this case -- the aforementioned pixel electrode 5 -- between -- and as it positioned in parallel, it has extended Therefore, for this reason, among these counterelectrodes 4A, some are formed, after the width of face has changed.

[0077] Thus, the electric fields E generated between the pixel electrodes and counterelectrodes which

were constituted differ a direction [on the direction in the top, and the bottom] among drawing bordering on the opposite voltage-signal line 4.

[0078] However, also in which [up-and-down] case, the absolute value of the angle to the gate line 2 of each electric field E is larger than the absolute value of the angle to a drain wire 3.

[0079] That is, it has composition which canceled by this un-arranging according to the viewing-angle dependency of the liquid crystal display panel which mentioned the molecule of liquid crystal above to it to the fixed direction of initial orientation (direction which meets the gate line 2), respectively as could rotate to the opposite direction.

[0080] namely, the direction where the aforementioned initial orientation direction met the gate line 2 -- becoming -- **** -- TFT substrate 1A and filter base board 1B -- swerving -- the direction of rubbing of the near orientation film of ** -- the extension direction of the gate line 2 -- almost -- coincidence attachment *****

[0081] And the spacer 10 fixed to a substrate is superimposed by the gate line 2, and is to be made and arranged.

[0082] The orientation disorder of the orientation film resulting from a spacer 10 will be produced along with the gate line 2, and this orientation disorder will be covered in this case by the gate line 2 or the shading field by the black matrix BM.

[0083] [Example 4] Drawing 6 is the plan showing other examples of the liquid crystal display by this invention, and serves as drawing 5 and corresponding drawing.

[0084] In this drawing, the pattern of the gate line 2, the opposite voltage-signal line 4, counterelectrode 4A, a drain wire 3, and pixel electrode 5 grade is the same as that of drawing 5.

[0085] In different composition from the case of drawing 5, the liquid crystal used has the negative dielectric constant anisotropy first.

[0086] And TFT substrate 1A and filter base board 1B swerve, and the direction of rubbing of the near orientation film of ** (the direction of initial orientation) is made along the direction which intersects perpendicularly with the gate line 2 mostly.

[0087] Furthermore, the spacer 10 fixed to a substrate is superimposed by the drain wire 3, and is to be made and arranged.

[0088] The orientation disorder of the orientation film resulting from a spacer 10 will be produced along with a drain wire 3, and this orientation disorder will be covered in this case by a drain wire 3 or the shading field by the black matrix BM.

[0089] [Example 5] Drawing 7 is explanatory drawing showing other examples of the liquid crystal display by this invention.

[0090] This drawing (a) shows the state of the array of each pixel of a liquid crystal display. A black frame shows the black matrix BM among drawing, and the opening shows each pixel.

[0091] It is called the so-called delta arrangement and 1 / 2 pitch gap ***** of each pixel group which meets an adjoining gate line (it extends in the x in drawing direction) are carried out. Since arrangement of such a pixel approaches mutually [R (red), G (green), and B (blue) equivalent to 1 pixel in color display] 3 pixels and it is arranged, it is known that color display quality will be made with a good thing.

[0092] In such a case, it sets, and while the spacer fixed to a substrate is arranged so that a gate line may be overlapped, the direction of rubbing of an orientation film (the direction of initial orientation) is the direction which met the gate line.

[0093] Thus, since the orientation disorder of the orientation film which originates in a spacer by constituting is arranged in the formation field of a black matrix and is not exposed from the opening, what degrades the quality of a display is lost.

[0094] If it furthermore explains to a detail, while superimposing the spacer fixed to a substrate on a drain wire and arranging it with the composition of this drawing (b) temporarily When the direction of rubbing of an orientation film (the direction of initial orientation) is made into the direction which intersects perpendicularly with a gate line It is because the orientation disorder of the orientation film resulting from a spacer 10 will be reached and formed even in the pixel field (inside of opening of a

black matrix) of 1 / 2 pitch gap ***** (or upper case) and degradation of the quality of a display will be brought about.

[0095] And in the liquid crystal display shown in this example, when adopting a horizontal electric-field method, it can consider as the pixel composition of drawing 4 and drawing 5 among the examples mentioned above, for example.

[0096] It is because the direction of rubbing of an orientation film (the direction of initial orientation) is the direction which met the gate line 2 while in the case of drawing 4 and drawing 5 the spacer 10 with which the all are fixed to a substrate is arranged so that the gate line 2 may be overlapped.

[0097] In addition, it cannot be overemphasized that the so-called vertical electric-field method is employable in the liquid crystal display shown in this example.

[0098] Namely, rubbing processing is made in the direction in which the orientation film by the side of each transparent substrate by which opposite arrangement of the liquid crystal display of a vertical electric-field method is carried out through liquid crystal intersects perpendicularly mutually, respectively.

[0099] For this reason, what is necessary is just to let the direction of rubbing processing of the orientation film by the side of this TFT substrate be the direction which met the gate line, while arranging the spacer in the position superimposed on a gate line, in making a spacer fix to a TFT substrate side. Moreover, what is necessary is just to let the direction of rubbing processing of the orientation film by the side of this filter base board be the direction which met the gate line, while arranging the spacer in the position superimposed on a gate line, in making a spacer fix to a filter base board side.

[0100] [Example 6] 1 / 2 pitch gap ***** thing is also known for each pixel group which meets an adjoining drain wire as the so-called composition of delta arrangement like the above-mentioned example 5.

[0101] In this case, while the spacer fixed to a substrate is arranged so that a drain wire may be overlapped, the direction of rubbing of an orientation film (the direction of initial orientation) is the direction which met the drain wire.

[0102] And when adopting a horizontal electric-field method in the liquid crystal display shown in this example, it can consider as the pixel composition of drawing 1 and drawing 6 among the examples mentioned above, for example.

[0103] It is because the direction of rubbing of an orientation film (the direction of initial orientation) is the direction which intersects perpendicularly with a gate line mostly while in the case of drawing 1 and drawing 6 the spacer 10 with which the all are fixed to a substrate is arranged so that a drain wire 3 may be overlapped.

[0104] Moreover, what is necessary is just to let the direction of rubbing processing of the orientation film by the side of this TFT substrate be the direction which met the drain wire, while arranging the spacer in the position superimposed on a drain wire, in making a spacer fix to a TFT substrate side in the case of the liquid crystal display of a vertical electric-field method. Moreover, what is necessary is just to let the direction of rubbing processing of the orientation film by the side of this filter base board be the direction which met the drain wire, while arranging the spacer in the position superimposed on a drain wire, in making a spacer fix to a filter base board side.

[0105] [Example 7] The example 6 mentioned above explains the liquid crystal display of the vertical electric-field method with which delta arrangement of the pixel was carried out.

[0106] However, a pixel can apply this invention also in the liquid crystal display of the vertical electric-field method by which delta arrangement is not carried out.

[0107] As mentioned above, the direction of rubbing of each orientation film of each transparent substrate by which opposite arrangement of the liquid crystal display of a vertical electric-field method is carried out through liquid crystal lies at right angles, and the direction of rubbing of the orientation film by the side of one substrate can be set up arbitrarily.

[0108] For this reason, what is necessary is making it just arrange this spacer in the position superimposed on a gate line, when a spacer's is fixed to a TFT substrate side and the direction of rubbing

of the orientation film by the side of the TFT substrate is set up along with a gate line. Moreover, what is necessary is fixing a spacer to a filter base board side, and making it just arrange this spacer in the position superimposed on a drain wire, when the direction of rubbing of the orientation film by the side of the TFT substrate is set up along the direction which intersects perpendicularly with a gate line mostly.

[0109] Furthermore, what is necessary is fixing a spacer to a TFT substrate side, and making it just arrange this spacer in the position superimposed on a drain wire, when the direction of rubbing of the orientation film by the side of the TFT substrate is set up along the direction which intersects perpendicularly with a gate line. Moreover, what is necessary is making it just arrange this spacer in the position superimposed on a gate line, when a spacer's is fixed to a filter base board side and the direction of rubbing of the orientation film by the side of the TFT substrate is set up along with a gate line.

[0110] [Example 8] Drawing 8 is drawing showing other examples in a horizontal electric-field method among the liquid crystal displays by this invention.

[0111] This drawing is a cross section cut along with one of each gate lines of a liquid crystal display, and it has the spacer 10 fixed to the filter base board 1B side which counters TFT substrate 1A.

[0112] and the aforementioned spacer 10 consists of a spacer (: called 1st spacer 10B -- it exists in the field B in drawing) holding the gap of each substrate, and a spacer (: called 2nd spacer 10A -- it exists in the field A in drawing) which is superimposed by the ends of each gate line, respectively and is especially arranged to them

[0113] Furthermore, as it superimposes on each gate line by the side of TFT substrate 1A, respectively, the conductive layer 21 is formed in the field by the side of the liquid crystal of filter base board 1B, respectively.

[0114] In this case, the gate line 2 by which each [these] conductive layer 21 will be formed in the state of carrying out the clothing of the 2nd spacer 10A inevitably, and opposite arrangement is carried out in the part of this 2nd spacer 10A, and electric connection come to be made.

[0115] From this, the gate line 2 comes to do so the effect that the open circuit will be protected by this detour circuit even if it will have a detour circuit apart from the signal line of it original and an open circuit occurs on the gate line 2.

[0116] And although it explains the protection network of the gate line 2, the example mentioned above cannot be overemphasized by that it is applicable as it is when protecting a drain wire 3. In this case, the gate line 2 in drawing will be transposed to a drain wire 3.

[0117] In addition, this example cannot be overemphasized by that you may apply in the composition of the liquid crystal display of a horizontal electric-field method among each example mentioned above.

[0118] [Example 9] Drawing 9 is drawing showing other examples of the thing of a vertical electric-field method among the liquid crystal displays by this invention.

[0119] This drawing is a cross section cut along with one of each gate lines 2 of a liquid crystal display, and it has the spacer 10 fixed to the filter base board 1B side which counters TFT substrate 1A.

[0120] the aforementioned spacer 10 consists of spacer (: called 3rd spacer -- it exists in field A in drawing) 10A arranged near the sealant 24 which carries out the seal of each substrate to spacer (: called 1st spacer -- it exists in field B in drawing) 10B holding the gap of each substrate especially

[0121] This 3rd spacer 10A is formed simultaneously with 1st spacer 10B at the time of the formation.

[0122] And each aforementioned spacer is also covered in the field by the side of the liquid crystal of filter base board 1B, and the common electrode (transparent electrode) 22 common to each pixel is formed in it.

[0123] Moreover, the conductive layer 23 electrically connected with the common electrode 22 which covers this 3rd spacer 10A is formed in the TFT substrate 1A page which contacts 3rd spacer 10A among each aforementioned spacer.

[0124] This conductive layer 23 extends exceeding a sealant 24 on TFT substrate 1A, and is connected to the terminal for supplying a reference signal to the aforementioned common electrode 22.

[0125] Therefore, when a reference signal is supplied to this terminal on TFT substrate 1A, this reference signal comes to be supplied to the common electrode by the side of filter base board 1B

through the portion of 3rd spacer 10A.

[0126] Thus, the constituted liquid crystal display comes to do so the effect of it becoming unnecessary to establish especially the electric conduction means for pulling out the common electrode 22 to TFT substrate 1A page. In addition, this example cannot be overemphasized by that you may apply in the composition of the liquid crystal display of a vertical electric-field method among each example mentioned above.

[0127] [Example 10] Each example mentioned above explained the thing which made the spacer fix to a TFT substrate side, or the thing which made the spacer fix to a filter base board side.

[0128] However, when especially property degradation of TFT needs to be prevented, it is desirable to make a spacer fix to a filter base board side.
 [0129] It is because the increase in the selective-etching process by the photolithography technology for forming the spacer will be brought about and degradation of TFT will be brought about with the medicine used for it, when making a spacer fix to a TFT substrate side.

[0130] Moreover, when a spacer needs to be arranged with a precision sufficient in position to a TFT substrate, it is desirable to make a spacer fix to a TFT substrate side.

[0131] It is because position **** arises and a spacer may be arranged with a precision sufficient in position to a TFT substrate, in case opposite arrangement of the filter base board is carried out to a TFT substrate, when making a spacer fix to a filter base board side.

[0132] [Example 11] Drawing 10 is the cross section having shown the detail of the spacer 10 formed in the filter base board 1B side by fixing.

[0133] The black matrix BM and a light filter 7 are formed, and in order to make a front face flat on those upper surface, the flat film 8 which consists of a thermosetting resin film is formed in the field by the side of the liquid crystal of filter base board 1B.

[0134] And although the spacer 10 is formed in the predetermined part of this flat film 8, this spacer 10 consists of resin films of a photoresist.

[0135] Since it becomes unnecessary to perform the process of selective etching by constituting a spacer 10 with the resin film of a photoresist, reduction of a manufacturing process can be aimed at. In addition, this example cannot be overemphasized by that you may apply in the composition of each example mentioned above, respectively.

[0136] Moreover, it is not necessary to necessarily limit to the filter base board 1B side, and when forming in the TFT substrate 1A side, it can apply.

[0137] [Example 12] Drawing 11 (a) is drawing having shown the spacer 10 arranged as was overlapped on the black matrix BM which draws the profile of each pixel in a display.

[0138] Thus, although the spacer 10 arranged is uniformly arranged as the whole display, one spacer 10 is arranged to the pixel of the simultaneously same number which adjoined mutually.

[0139] The number of the spacers 10 in a display is reduced, and orientation disorder which originates in this spacer in connection with this is lessened.

[0140] This does so the effect that prevention of the contrast by optical leakage (in the case [Especially] of a black display) can be aimed at.

[0141] [Example 13] The arrangement is not uniform while drawing 11 (b) is reducing the number of the spacers 10 in **** like the example 12, and the point which is random (there being nothing homogeneity) differs from the example 12.

[0142] Since it is easy to recognize it when the portion of optical leakage has occurred by the pattern as a property of human being's visual sense repeatedly, it has canceled the un-arranging by arranging a spacer without homogeneity.

[0143] [Example 14] Drawing 12 is explanatory drawing showing other examples of the liquid crystal display by this invention, and serves as drawing corresponding to drawing 2 or drawing 10.

[0144] It is placed between the contact sections of this spacer 10 between the transparent substrate of the side to which the spacer 10 was fixed, and other transparent substrates which counter by adhesives 30 in this drawing.

[0145] The contact section of this spacer 10 is the contact section of orientation films, and since these

are these material, un-arranging [that the fixing force is weak] produces them.

[0146] So, the reliability of maintenance of the gap between each transparent substrate can be secured now by using for example, Si coupling agent as these adhesives.

[0147] Next, one example of the manufacture method of the liquid crystal display which consists of such composition is explained using drawing 13 .

[0148] That in which the spacer 10 was formed in process 1. one substrate, the spacer 10 was also covered and the orientation film was formed is prepared (this drawing (a)).

[0149] The aforementioned substrate is made to approach the container with which process 2. adhesives were filled, and the front face of these adhesives 30 is contacted in the crowning of the spacer 10 (this drawing (b)).

[0150] It can process 3. Come, and is alike, and adhesives 30 come (this drawing (c)) to be applied more to the crowning of a spacer 10.

[0151] Opposite arrangement of the process 4. above-mentioned substrate is carried out with other substrates (this drawing (d)).

[0152] Adhesives 30 are stiffened by adding process 5. heat treatment. Thereby, a spacer 10 will be in the state where it fixed to each of each substrate (this drawing (e)).

[0153] Moreover, other examples of the manufacture method of the liquid crystal display which consists of composition mentioned above are explained using drawing 14 .

[0154] That in which the spacer 10 was formed in process 1. one substrate, the spacer 10 was also covered and the orientation film was formed is prepared (this drawing (a)).

[0155] The equipment equipped with a roller 31 with the container with which the process 2. adhesives 30 were filled is prepared, and the adhesives which adhere to the front face by rotation of this roller 31 are made to apply to the crowning of the aforementioned spacer (this drawing (b)).

[0156] It can process 3. Come, and is alike, and adhesives 30 come (this drawing (c)) to be applied more to the crowning of a spacer 10.

[0157] Opposite arrangement of the process 4. above-mentioned substrate is carried out with other substrates (this drawing (d)).

[0158] Adhesives 30 are stiffened by adding process 5. heat treatment. Thereby, a spacer 10 will be in the state where it fixed to each of each substrate (this drawing (e)).

[0159] In addition, this example cannot be overemphasized by that you may apply in the composition of the liquid crystal display of each example mentioned above.

[0160] [Example 15] Drawing 15 is explanatory drawing showing other examples of the liquid crystal display by this invention.

[0161] This drawing is equipped with the cavity 40 by which the crowning of this spacer is inserted in other substrates side which counter the substrate to which the spacer 10 was fixed.

[0162] And this cavity 40 is formed in the near protective coat 41 of TFT substrate 1A, and serves as the so-called shape of a back taper with a big area to the front face at the base side.

[0163] Thus, when constituted, the crowning eats into this cavity 40, and is arranged, and a spacer 10 becomes being the same as that of the state where it pasted up to TFT substrate 1A.

[0164] Moreover, drawing 16 is other examples which consisted of the same meanings, and constitutes a means to have the same function as the aforementioned cavity 40 from a slot between the signal lines (wiring) 42 of a couple.

[0165] And the side section which counters mutually [each signal line] in this case has become back taper-like. In addition, although the crowning of a spacer 10 consists of this example in the aforementioned cavity as it eats away, you may constitute so that a spacer 10 may be inserted in in the state where it is not necessarily limited to such composition, for example, is comparatively generous.

[0166] thus, the direction which each substrate estranges when it carries out -- receiving -- the movement -- being uncontrollable (however, a sealant taking charge of this function) -- it is because horizontal movement of each substrate can be regulated

[0167] Moreover, it can also use now as a positioning means at the time of carrying out opposite arrangement of each substrate by the spacer 10 and the aforementioned cavity in this case.

[0168] [Example 16] Drawing 17 is explanatory drawing showing other examples of the liquid crystal display by this invention.

[0169] This drawing shows the spacer 10 which was superimposed by the signal line of the gate line 2 or drain wire 3 grade, and was formed in it, near this spacer 10, the width of face becomes broad near this spacer, and the black matrix BM formed along with this signal line is formed.

[0170] If it puts in another way, the black matrix BM which covers a spacer 10 serves as a pattern which has the profile which has a path centering on this spacer [near this spacer 10].

[0171] in this case, this although the direction of rubbing of an orientation film is a direction in alignment with the signal line and being covered by black matrix 10 itself usually comes out of the orientation disorder resulting from the spacer 10 by this rubbing processing in this example, since the field which this orientation disorder generates may become large -- beforehand -- it is going to cancel -- it is a thing

[0172] In addition, from the meaning of covering the orientation disorder which forms the black matrix BM broadly and originates in a spacer 10, although the direction of rubbing of an orientation film should be formed along with the signal line in this example, even if the direction of rubbing of this orientation film is a direction which has an angle to a signal line, of course, it is applicable.

[0173] [Example 17] Drawing 18 is explanatory drawing showing other examples of the liquid crystal display by this invention, and has become a thing corresponding to drawing 17 .

[0174] First, unlike the case of drawing 17 , this drawing has an angle (theta) to a signal line, as the direction of rubbing of an orientation film shows all over drawing.

[0175] In this case, the orientation disorder of the orientation film resulting from a spacer extends in the angle theta direction to a signal line, and it comes to generate it.

[0176] For this reason, especially the black matrix BM is formed in the side which this orientation disorder has generated more greatly than the width of face of other portions of the extension direction.

[0177] If it puts in another way, although the black matrix BM which covers a spacer 10 has the profile which has a path centering on this spacer [near this spacer 10], this path is especially formed greatly in the direction which orientation disorder generates.

[0178] And since especially the direction that the orientation disorder which is the direction of rubbing of an orientation film and originates in a spacer 10 has not produced from this is deficient in the need of covering by the black matrix BM, as shown in drawing 19 , it cannot be overemphasized by that you may make it form a broad portion only in the one-side side of a black matrix.

[0179] [Example 18] Drawing 20 is explanatory drawing showing other examples of the liquid crystal display by this invention.

[0180] This drawing shows the spacer 10 which was superimposed by the signal line of the gate line 2 or drain wire 3 grade, and was formed in it, and has the composition that the shading metal layer 50 was formed in both the sides of this signal line [near this spacer 10].

[0181] In this example, this shading metal layer 50 is separated and formed in a signal line, and the crevice between them is shaded by the black matrix BM.

[0182] and this although the direction of rubbing of an orientation film is a direction in alignment with the signal line also in this case and it usually comes out of the orientation disorder resulting from the spacer 10 by this rubbing processing to be covered by a signal line or the black matrix BM itself, since the field which this orientation disorder generates may become large -- beforehand -- it is going to cancel -- it is a thing

[0183] In addition, the aforementioned shading metal membranes 50 may be a signal line and this layer, and may be different layers.

[0184] When forming the shading metal membrane 50 in a signal line and this layer, it can unite with this signal line and can also form.

[0185] And when forming the shading metal membrane 50 in a signal line and a different layer, it can form with the material of this signal line, and a different material. For example, when this signal line is a drain wire, it can form with the same material as a gate line or an opposite voltage-signal line.

[0186] Moreover, from the meaning of covering the orientation disorder which forms a signal line

broadly substantially and originates in a spacer, although the direction of rubbing of an orientation film should be formed along with the signal line, even if the direction of rubbing of this orientation film is a direction which has an angle to a signal line, of course, it is applicable.

[0187] [Example 19] Drawing 21 is the shading metal membrane 50 formed in the basis of the above-mentioned example and this meaning, and was formed only in one side to the signal line.

[0188] The shading metal membrane 50 is arranged according to the direction of the orientation disorder produced on the orientation film resulting from a spacer 10, and this shading metal membrane 50 is not arranged in the direction contrary to this direction.

[0189] the case of the example shown in this drawing, for example, rubbing processing of an orientation film, -- a signal line -- almost -- a rectangular cross -- it becomes effective when it is the direction of the left in a view the bottom

[0190] In this case, the effect that the degree which narrows the numerical aperture of a pixel as compared with an example 18 can be made small is done so.

[0191] [Example 20] Although drawing 22 had become the composition which has arranged the shading metal membrane 50 by both side of a signal line, respectively like the example 18, the shading metal membrane 50 of another side was formed for a long time along the extension direction of a signal line to one shading metal membrane 50.

[0192] Each shading metal membrane 50 is arranged according to the direction [film / orientation / resulting from a spacer 10] of orientation disorder. by this To the shading field which consists of a signal line and each shading metal membrane 50 (the black matrix BM is included) The profile which has a path centering on this spacer 10 near this spacer 10 is given, and the diameter of this is enlarged towards the orientation disorder of an orientation film having occurred among the directions of the aforementioned rubbing processing.

[0193] [Example 22] The shading metal membrane 50 in the example mentioned above is constituted as what gives only the function of shading.

[0194] However, this shading metal membrane 50 cannot be overemphasized by that you may make it give the function to the electrode which exists in a pixel.

[0195] Drawing 23 is constituted in the pixel composition which shows one example in such a case and was shown in drawing 1 as a thing which made common electrode 4A positioned by both the sides of a drain wire 2 have the function of the aforementioned shading metal membrane.

[0196] Un-arranging according to the orientation disorder of the orientation film resulting from a spacer can be avoided with sufficient reliability, without making the elated shading metal membrane 50 form by making it superimpose on the drain wire 3 which common electrode 4A was made to adjoin and was formed, and arranging a spacer 10, without making it superimpose on the gate line 2, and arranging a spacer 10, if it puts in another way.

[0197] Also in this case, especially the direction of initial orientation is not limited.

[0198] [Example 23] Drawing 24 is explanatory drawing showing other examples of the liquid crystal display by this invention. This drawing (a) is a plan and this drawing (b) is a cross section in the b-b line of this drawing (a).

[0199] In this drawing, there are TFT substrate 1A and filter base board 1B by which opposite arrangement is mutually carried out through liquid crystal, and while each [these] substrate of each other is fixed by the sealant 24 which encloses this liquid crystal, a predetermined gap is secured in the portion in which this sealant 24 was formed.

[0200] And the field surrounded, the enclosure field 24, i.e., the sealant, of liquid crystal, turns into a viewing area, and in this viewing area, the spacers 10 for securing the gap of each substrate of this viewing area are scattered, and are arranged.

[0201] As the example mentioned above showed this spacer 10, it was fixed and formed in one substrate side, and the cross section in a field parallel to this substrate is equally formed in this example.

[0202] And when the aforementioned viewing area is classified into the center section except the periphery (near sealant 24) and its periphery, the number of this spacer 10 in a periphery has become less than the number in a center section.

[0203] That is, these spacers 10 are arranged smaller than the density in the center section excluding [the density per unit in the periphery of a viewing area] this periphery.

[0204] Here, the aforementioned density becomes appropriate [assuming as density of 1cm² or the spacer 10 whose 1mm exists in the area of 2] with enlargement of the target liquid crystal display panel.

[0205] Thus, the constituted liquid crystal display is exactly strengthening bearing power to the substrate of the spacer group arranged at a periphery in the bearing power to the substrate of the spacer group arranged in the center section of the viewing area.

[0206] The liquid crystal display panel has enlarged the liquid crystal display in recent years, and if the center section of the viewing area positioned distantly [sealant / 24] does not make bearing power to the substrate of a spacer larger than the periphery, it uses as an evasion plug un-arranging / it becomes impossible to hold the gap of each substrate to homogeneity over the whole region /.

[0207] Moreover, the spacer 10 which is fixed to a substrate and formed can form the spacer 10 of composition of having mentioned above in the material layer of this spacer 10 formed all over this substrate easily from the ability to be able to arrange at a position at a desired pattern by the selective etching (the composition shown in drawing 10 can form only with photolithography technology) using photolithography technology.

[0208] Moreover, you may make it arrange the density of the spacer 10 in the periphery of the field where liquid crystal was enclosed in this case, and the density of the spacer 10 in the center section except this periphery so that it does not change in level difference on the boundary of a periphery and a center section, but may apply to a center section and may change from a periphery smoothly.

[0209] When it does in this way, **** does so the effect that it is avoidable that a portion arises, about the gap of the substrate which counters.

[0210] In addition, the example mentioned above cannot be overemphasized by that it is made to make the densities of a spacer 10 differ in the center section and periphery for example, in x in drawing direction, and the density of a spacer 10 may be similarly constituted in the center section and periphery in the direction of y in drawing.

[0211] Moreover, although the example mentioned above can be carried out together with other examples of a specification, it cannot be overemphasized by that it is not necessary to do in this way.

[0212] [Example 24] Although each spacers 10 in a viewing area are equally scattered as the same meaning as an example 23 shows to drawing 25 again, you may constitute so that the cross section in a field parallel to the substrate of the spacer 10 in the center section of this viewing area may become larger than the cross section in respect of the above of the spacer 10 in a periphery.

[0213] Also in this case, each spacer can be easily formed by performing the selective-etching method which used for example, photolithography technology for the material layer of the spacer 10 formed throughout the substrate side.

[0214] Furthermore, the same effect can be acquired even if it makes material strength of the spacer of the center section of the viewing area larger than the material strength of the spacer of a periphery.

[0215] [Example 25] It is as having mentioned above that each spacer mentioned above can be easily arranged in arbitrary parts within a viewing area.

[0216] And it is made to arrange this spacer in the liquid crystal display for colors in this example to other shading fields other than the shading field which draws the pixel in which the green (G) filter is formed.

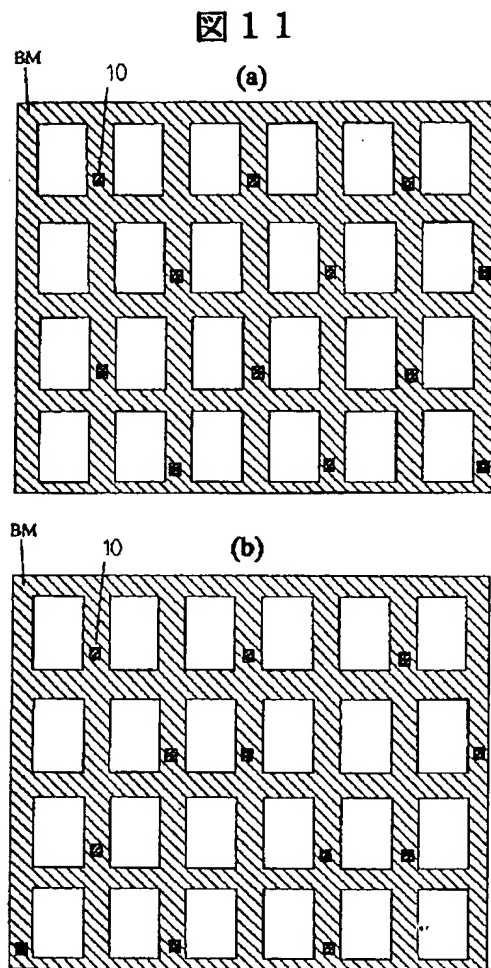
[0217] It is made to arrange this spacer, if it puts in another way so that the shading field which draws the pixel in which the shading field or blue (B) filter which draws the pixel in which the red (R) filter is formed is formed may be overlapped.

[0218] Green (G) is the meaning which prevents making optical leakage sense in view of a light transmittance being the highest as compared with other colors, and being sensitive to human being's visual sense with the spacer arranged near the pixel which penetrates this color (inside of a shading field).

[0219]

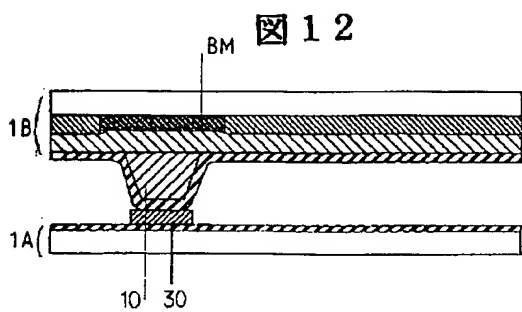
[Effect of the Invention] Since it explained above, according to the liquid crystal display by this invention, a thing without the display unevenness by orientation disorder can be obtained.

[Translation done.]

Drawing selection ☒

[Translation done.]

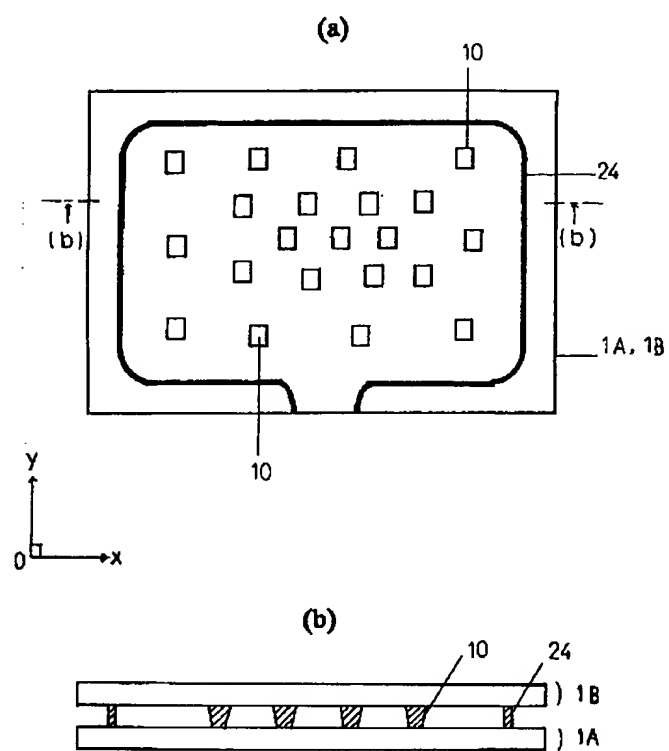
Drawing selection ☒



[Translation done.]

Drawing selection ☒

図 2 4



[Translation done.]